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PARITY AND SUGAR FEEDING IN *ATYLOTUS BICOLOR* (DIPTERA: TABANIDAE)

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Abstract.—During 1983–1985, females of *Atylotus bicolor* were collected in dry-ice baited canopy traps at 4 sites in Connecticut. Parity and stage of follicle development were determined for 52 females, all of which completed at least one gonotrophic cycle and had terminal ovarian follicles in early stages of development. Nearly half of the females contained detectable amounts of fructose. It is suspected that females produce eggs without blood meals during the first ovarian cycle and metabolize sugars for survival and dispersal.

Immatures and adults of *Atylotus bicolor* (Wiedemann) have been collected at numerous sites in northern United States and southern Canada (Teskey, 1969, 1983). Larvae can develop in a variety of habitats including sphagnum bogs, the margins of ponds in pastures, wooded and open swamps, and in vegetation-free soils at the edges of streams and rivers. The females rarely bite humans, but they have been observed near cattle and readily enter dry ice baited canopy traps (Pechuman, 1981). Although it appears that these insects seek vertebrate blood, little is known about their feeding habits and reproductive biology. This horsefly co-exists with other tabanid species that have been found carrying the etiologic agent for Lyme disease, *Borrelia burgdorferi,* (Magnarelli et al., 1986). This study was conducted to assess vector potential in *A. bicolor* by determining stage of follicle development and parity and to determine if females ingest plant sugars for sustenance.

METHODS

During June through August of 1983–1985, canopy traps (Pechuman, 1981) were erected at least once a week in pastures or salt marshes in the following Connecticut communities: East Haddam, Newtown, Norwich, or Milford. The first 3 are inland sites, while the last is a coastal town. In each setting, the canopy traps were placed in open areas and were baited with 2–3 kg of dry ice. Tabanids were removed from the trap heads at hourly intervals from 1000 to 1500 hours, transported on crushed ice to the laboratory, and were either dissected promptly or frozen at −60°C. Ovaries were removed in Ringer's saline solution, and ovarioles were teased apart to determine gonotrophic age and stage of follicle development. Dissection procedures and terminology of ovarian structures follow Detinova (1962), and parity was determined by using Polovodova's method (in Detinova, 1962). Distended follicular tubes, herein designated as sac-stage, indicate recent oviposition (i.e., usually within 48 hours), whereas contracted tissues containing well-defined follicular relics were examined to determine the number of completed ovarian cycles. Follicle development was graded by using Mer's (1936) modification of Christophers' (1911) classification.

To test for fructose or fructose-yielding sugars, such as sucrose, the remaining insect body parts were crushed as described earlier (Magnarelli and Anderson, 1981) and combined with 0.75 ml of cold anthrone reagent. This test was modified from that of Van Handel (1972) to analyze the larger-sized insects. Results were recorded within 1 hour. Although fructose and sucrose are common nectar sugars (Percival, 1961), they are also present in fruit juices (Van Handel et al., 1972) and aphid honeydew (Auclair, 1963).

RESULTS

The earliest record of capture of *A. bicolor* was 9 July, while the latest was 24 August (Table 1). The maximum number of females captured during any 7 hours of trapping effort was 9. All specimens were obtained between 1200 and 1500 hours on warm, sunny days.

Ovarian examinations revealed that all 52 females had oviposited at least once and were, therefore, considered parous. Of these, 43 (82.7%) had sac-staged follicular tubes with terminal follicles in very early stages of development (i.e., little or no yolk deposited) or in stage II. All 9 females with contracted follicular tubes contained one relic per ovariole and had secondary follicles in stage II. None of the females had vertebrate blood in the midgut. Fructose was detected in 24 females from all study sites. This sugar was present in specimens that had sac-like follicular tubes or contracted, follicular relics. In addition, there was no correlation between stage of follicle development and sugar-positivity.

DISCUSSION

Results obtained in Connecticut parallel those published earlier on geographically different populations (MacCreary, 1940; Pechuman and Burton, 1969; and Smith et al., 1970) and show that females are not routinely collected in carbon dioxide baited traps. Since all of the females examined in the present study were parous, there were no instances of females attacking cattle or humans, and since there was no vertebrate blood in digestive tracts, these insects probably produce eggs autogenously (i.e., without blood meals) during the first ovarian cycle. At the start of the second cycle, the females, like those of many other tabanid species (Thomas, 1972; Magnarelli, 1976), probably require vertebrate blood to develop eggs (anautogeny), and because they are attracted to carbon dioxide, they may enter dry ice baited traps. Although vector potential for *A. bicolor* is low, autogeny should be confirmed by allowing the females to produce eggs from stored nutrients carried over from the larval stage. Autogeny has been reported for other tabanids (Anderson, 1971; Lake and Burger, 1980; Lane et al., 1983; Thomas, 1972) and may be more prevalent than previously thought.

Relatively few adults were obtained in canopy traps, but this does not necessarily mean that *A. bicolor* is a rare species. According to Pechuman (1981), when traps are placed near the breeding sites, such as freshwater marshes, females can be readily collected. In addition to trap location, the low numbers of females captured in other habitats might be due, in part, to heavy mortality associated with the completion of the first ovarian cycle. Males do not enter canopy traps.

Similar to other tabanids, such as species of *Chrysops*, *Hybomitra*, and *Tabanus* (Magnarelli and Anderson, 1981), females of *A. bicolor* acquire fructose or sucrose

Table 1. Parity, follicular development, and presence of fructose in females of *A. bicolor* captured in canopy traps during 1983–1985.

Sites	Dates of collection	Total females	No. of parous specimens						No. with fructose
			Sac stage			Follicular relics			
			I*	I–II	II	I	I–II	II	
Milford	15 July 1983	9	0	6	2	0	0	1	5
	19 July 1983	1	0	1	0	0	0	0	1
East Haddam	23 July 1983	3	0	3	0	0	0	0	2
	24 Aug. 1983	9	0	4	2	0	0	3	2
Newtown	2 Aug. 1983	8	0	4	3	0	0	1	4
East Haddam	17 July 1984	3	0	1	2	0	0	0	2
	24 July 1984	2	0	0	0	0	0	2	1
Norwich	9, 10 July 1985	4	2	0	0	0	0	2	3
	29 July 1985	1	1	0	0	0	0	0	0
	11 Aug. 1985	1	1	0	0	0	0	0	0
East Haddam	16 July 1985	1	1	0	0	0	0	0	0
	18 July 1985	1	1	0	0	0	0	0	0
	22 July 1985	3	1	2	0	0	0	0	2
	30 July 1985	6	5	1	0	0	0	0	2
Totals		52	12	22	9	0	0	9	24

* Roman numerals refer to stages of terminal follicle development.

and probably utilize these carbohydrates to meet the high energy demands of flight. The specific food sources and frequency of sugar feeding for *A. bicolor* adults are unknown, but if amounts of stored energy reserves are low when females start the second ovarian cycle, these sugars along with glycogen and triglyceride reserves will enhance survival and provide energy for dispersal. Therefore, the females collected in a salt marsh habitat in Milford may have originated in inland sites, which were adjacent to the marshes, and may have dispersed to the study area.

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